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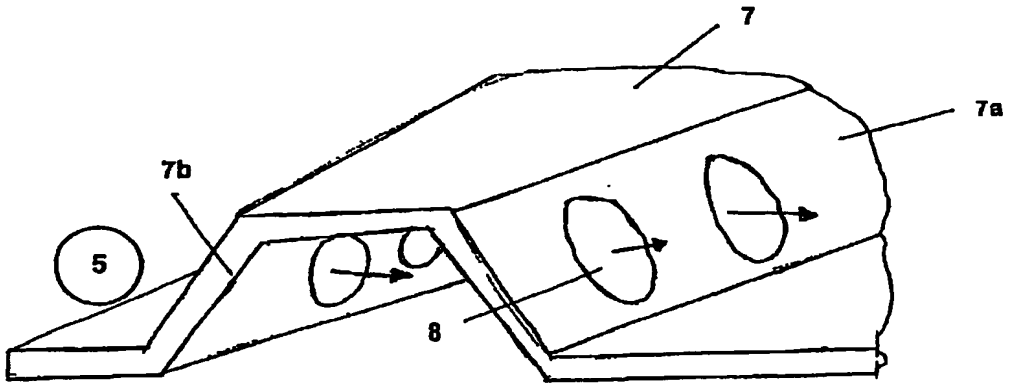
(54) Title: ELECTROCHEMICAL SYSTEM



(57) Abstract: The invention deals with an electrochemical system for compressing gases and/or for producing gases by electrolysis, consisting of an electrochemical compressor stack (1) having layering of several electrochemical cells, which are separated from one another in each case by bipolar plates (3; 3'), wherein the bipolar plates have openings for media supply and media discharge (5a, 5b) for the electrochemical cells and the electrochemical cell stack can be placed under mechanical compressive strain in direction (6) of the layering. The bead arrangements (7; 7') are resilient and are provided at least in some regions to seal the openings (4, 5a, 5b) and/or an electrochemically active region (10) of the electrochemical cells.

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— *with amended claims*

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AMENDED CLAIMS

[Received by the International Bureau on 22 December 2004 (22.12.04) : original claims 1-42 replaced by new claims 1-42]

1. Electrochemical compressor system for compressing gases and/or for producing gases by electrolysis, consisting of an electrochemical compressor stack (1) having layering of several electrochemical cells, which are separated from one another in each case by bipolar plates (3; 3'), wherein the bipolar plates have openings for media supply and media discharge (5a, 5b) for the electrochemical cells and the electrochemical cell stack can be placed under mechanical compressive strain in direction (6) of the layering, characterised in that bead arrangements (7; 7') which are resilient are provided at least in some regions to seal the openings (4, 5a, 5b) and/or an electrochemically active region (10) of the electrochemical cells and that the bead arrangement is made from metals.

2. Electrochemical compressor system according to claim 1, characterised in that the electrochemical cells have gas diffusion layers (9) made from conductive structures, such as metal fibres, on their sides facing the bipolar plates.

3. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement (7; 7') is coated to microseal media.

4. Electrochemical compressor system according to claim 3, characterised in that coating is ef-

fected using an elastomer.

5. Electrochemical compressor system according to one of claims 3 or 4, characterised in that coating is effected by means of screen-printing processes, tampon printing, spraying or CIPG.

6. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement (7; 7') contains a full bead or a half bead.

7. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement (7; 7') is made from steel, nickel, titanium, aluminium, and alloys having a high proportion of these metals.

8. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement has a stopper which limits compression of the gas diffusion layer to a minimum thickness.

9. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement (7; 7') is connected to the bipolar plate (3; 3').

10. Electrochemical compressor system according to claim 8, characterised in that the bipolar plate (3; 3') is designed as a whole as a metal moulding.

11. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement is arranged on a component which is separate from the bipolar plate,

which component is placed on graphite, plastic, metal or the like or integrated by adhesion, clicking-in, welding-in, soldering-in or moulding-in.

12. Electrochemical compressor system according to claim 8, characterised in that the bipolar plate (3; 3') is designed as a composite element of two metal plates having a plastic plate lying therebetween.

13. Electrochemical compressor system according to one of the preceding claims, characterised in that the electrochemically active region of the electrochemical cells is arranged in an essentially closed chamber (10), which is limited essentially annularly laterally by the bead arrangement.

14. Electrochemical compressor system according to claim 13, characterised in that the bead arrangement is designed at least in some regions as a half bead which is open towards the electrochemically active region/closed chamber (10)

15. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement is designed as an elastomer roll which is applied by screen or tampon printing or moulded on as a roll.

16. Electrochemical compressor system according to one of the preceding claims, characterised in that it is an electrolyser which cleaves water introduced on one side of the electrochemical cell electrochemically into molecular hydrogen and oxygen.

17. Electrochemical compressor system according to one of the preceding claims, characterised in that it is a hydrogen compressor, which oxidises molecular hydrogen introduced on the first side of a proton-conducting electrochemical cell to H^+ and reduces it again on the second side back to molecular hydrogen, wherein the molecular hydrogen there is subjected to a higher pressure on the second side than on the first side due to the sealing and spatial arrangement.

18. Electrochemical compressor system according to one of the preceding claims, characterised in that the gas pressure in the electrochemically active region is sealed off so that the gas pressure prevailing there in the closed chamber (10) without leakage losses may be over 100 bar, preferably over 200 bar, particularly preferably over 500 bar.

19. Electrochemical compressor system according to one of the preceding claims, characterised in that resilient bead arrangements (7, 7') are provided around the openings (4; 5) of the bipolar plate and/or the electrochemically active region, wherein perforations (8, 8') for conducting liquid or gaseous media are arranged on at least one flank (7a, 7a') of the bead arrangements.

20. Electrochemical compressor system according to claim 19, characterised in that the perforations (8, 8') are circular, oval or angular.

21. Electrochemical compressor system according to one of claims 19 or 20, characterised in that a duct (28) is connected to a perforation (8'),

wherein the duct is connected to the beading interior (10') and is closed at least towards the beading outer surface.

22. Electrochemical compressor system according to one of claims 19 or 20, characterised in that the perforations (8) are open towards the electrochemically active region of the cell.

23. Electrochemical compressor system according to claim 19, characterised in that the bipolar plate (3) is constructed from two plates (3a, 3b), which have a cavity (13;14) lying therebetween for cooling agent and/or conducting media fluids (14).

24. Electrochemical compressor system according to claim 6, characterised in that the full bead contains perforations (8;8') on one (7a) or on both flanks (7a; 7b).

25. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement (7, 7') is part of a plate (3a, 3b) belonging to the bipolar plate.

26. Electrochemical compressor system according to one of the preceding claims, characterised in that the bead arrangement (7, 7') has essentially the same stiffness for stresses in direction (6) of the layering in the perforated and the non-perforated flank regions.

27. Bipolar plate for an electrochemical compressor system according to one of claims 1 to 26.

28. Fuel cell system consisting of a fuel cell stack (1) having layering of several fuel cells (2),

which are separated from one another in each case by bipolar plates (3), wherein the bipolar plates have openings for cooling (4) or media supply and media discharge (5a;5b) for the fuel cells and the fuel cell stack can be placed under mechanical compression strain in direction (6) of the layering, characterised in that resilient bead arrangements (7, 7') are provided around the openings (4; 5) of the bipolar plate, wherein perforations (8, 8') for conducting liquid or gaseous media are arranged on at least one flank (7a, 7a') of the bead arrangements and that the bead arrangements are made from metals.

29. Fuel cell system according to claim 28, characterised in that the perforations (8, 8') are circular, oval or angular.

30. Fuel cell system according to one of claims 28 or 29, characterised in that a duct (28) is connected to a perforation (8'), wherein the duct is connected to the beading interior (10') and is closed at least towards the beading outer surface.

31. Fuel cell system according to one of claims 28 or 29, characterised in that the perforations (8) are open towards the electrochemically active region (10) of the fuel cell.

32. Fuel cell system according to one of claims 28 to 31, characterised in that the bipolar plate (3) is constructed from two plates (3a, 3b), which have a cavity (13;14) lying therebetween for cooling agent and/or conducting media gases.

33. Fuel cell system according to one of claims 28 to 32, characterised in that the bead arrange-

ment (7, 7') contains a full bead or a half bead.

34. Fuel cell system according to claim 33, characterised in that the full bead contains perforations (8) on one (7a) or on both flanks (7a; 7b).

35. Fuel cell system according to one of claims 28 to 34, characterised in that the bead arrangement (7; 7') consists of steel, nickel, titanium or aluminium.

36. Fuel cell system according to one of claims 28 to 35, characterised in that the bead arrangement (7, 7') is part of a plate (3a) belonging to the bipolar plate.

37. Fuel cell system according to one of claims 28 to 35, characterised in that the bead arrangement is arranged on a component which is separate from the bipolar plate, which component is placed on bipolar plates made from graphite, plastic, metal or the like or connected to the bipolar plate by adhesion, clicking-in, welding-in, soldering-in or moulding-in.

38. Fuel cell system according to one of claims 28 to 37, characterised in that the bead arrangement (7; 7') is coated to microseal media.

39. Fuel cell system according to one of claims 28 to 38, characterised in that an electrochemically active region of the fuel cell is arranged in an essentially closed chamber (10), which is limited essentially annularly laterally by a bead arrangement.

40. Fuel cell system according to one of claims 28 to 39, characterised in that the bead arrangement (7, 7') has essentially the same stiffness for stresses in direction (6) of the layering in the perforated and the non-perforated flank regions.

41. Bipolar plate for a fuel cell system according to one of claims 28 to 40.

42. Process for producing a bipolar plate according to claim 27 or according to claim 41, characterised in that a metal plate is provided with holes first of all and then mechanical shaping of the perforated plate takes place to produce the bead arrangement so that the holes are perforations in at least one flank of the bead arrangement.